SUPPLIER SELECTION

AND

SUPPLIER MANAGEMENT STRATEGY

AN IMPORTANT STRATEGIC DECISION IN

MANUFACTURING FLEXIBILITY

by

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ABSTRAK

"Persaingan tidak lagi di antara syarikat dengan syarikat, tetapi rantaian bekalan dengan rantaian bekalan" John Grossman, Timbalan Presiden pengurusan bahan bekalan AlliedSignal sudah menegaskan kepentingan SCM sejak kebelakangan ini.

Perubahan teknologi yang cepat, persaingan yang sengit dan keseluruhan pasaran memerlukan bekalan rantaian yang lentur supaya keperluan pelanggan yang sentiasa berubah dapat dipenuhi. Tambahan lagi, dengan pertambahan aktiviti pembuatan luaran dan kitaran hayat barangan yang pendek, peranan yang dimainkan oleh pembekal menjadi sangat penting kepada pengusaha kilang. Strategi yang betul dalam pemilihan pembekal-pembekal dan pengurusan mereka akan memastikan pembekal-pembekal yang sesuai dipilih. Ini dapat menjamin para pembekal selalu berusaha untuk berseiringi dengan taraf teknologi pengusaha yang canggih, seperti pengeluaran yang pantas.

Populasi kajian ini terdiri daripada 120 firma perkilangan yang berada di negeri Pulau Pinang. Sejumlah 120 borang soal-selidik telah diberikan kepada responden, tetapi hanya sejumlah 92 maklumbalas yang boleh digunakan. Ini telah memberi peratusan jawapan sebanyak 77%.

Hasil kajian menunjukkan pemilihan pembekal-pembekal dengan mengutamakan strategi teknologi berbanding dengan strategi kualiti, kos and pencapaian dalam penghantaran, adalah keputusan yang penting, jikalau pengusaha menegaskan produk dan pelancaran yang lentur. Namun demikian, bila pengusaha firma menegaskan kuantiti yang lentur, kualiti menjadi strategi yang penting berbanding dengan teknologi, kos and pencapaian dalam penghantaran dalam pemilihan pembekal-pembekal.

Penyelidikan ini juga menunjukkan penglibatan awal pembekal-pembekal, perancangan kualiti dan perancangan teknologi menpengaruhi perhubungan di antara pemilihan pembekal dengan pelancaran yang lentur. Strategi pengurusan pembekal tidak mempamerkan sebarang kesan-kesan pengaruh yang ketara ke atas produk dan kuantiti yang lentur. Sebenarnya, perancangan kualiti, perancangan teknologi and pengurusan bahan bekalan bertindak sebagai peramal bagi semua model melibatkan kualiti lenturan. Perancangan teknologi and pengurusan bahan bekalan didapati memainkan peranan peramal dalam model melibatkan produk lenturan dan pelancaran lenturan masing-masing.

Kajian ini membuka peluang bagi penyelidikan seterusnya dalam rantaian bekalan selepas aktiviti pengusaha. Untuk memenuhi sepenuhnya permintanan pelanggan, pengusaha harus memastikan activiti selepas pengusaha seperti sistem pengagihan and logistik adalah baik untuk memuaskan permintaan pelanggan. Namun demikian, seseorang haruslah berhati-hati bila menggunakan hasil kajian ini memandangkan batasan-batasan yang wujud dalam pengajian ini.

ABSTRACT

"Competition is no longer company to company, but supply chain to supply chain". John Grossman, vice president of materials management at AlliedSignal had highlighted the strategic important of supply chain management nowadays.

The rapid rate of technology change, stiff competition and globalization of market have demanded a highly flexible supply chain in order to satisfy the customer's changing expectation. Furthermore, with the increasing of outsourcing activities and shortened of product life cycles, the role of the supplier is increasingly important to the manufacturer. The right strategy of supplier selection and management will ensure the right suppliers are selected, and always stay abreast with the manufacturer's latest state-of-the-art technology, such as agile manufacturing, to continuously support the manufacturer in managing its flexible supply chain.

The population for this study is the manufacturer in the Penang State. 120 survey questionnaires were sent out and only 92 usable responses were received, constituting a response rate of 77%.

The results reveal that selection of supplier based on technology in comparison with quality, cost and delivery performance is an important strategic decision when manufacturer is emphasizing on product and launch flexibilities. However, when the manufacturer's emphasis is on volume flexibility, quality is a strategic decision in supplier selection compared to technology, cost and delivery performance.

It is found that among the four supplier management strategies, supplier early involvement, quality roadmap and technology roadmap moderate the relationship of supplier selection and launch flexibility. Supplier management strategy does not have any moderation effect on product and volume flexibilities. In fact, quality roadmap,

technology roadmap and inventory management act as predictor variables in each of the volume flexibility model. Technology roadmap and inventory management appear to be predictor variables in product flexibility and launch flexibility models respectively.

This study provides an avenue for further exploration on the flexible supply chain downstream to the manufacturer. To fully meet the customer's needs, the manufacturer must ensure its downstream supply chain such as manufacturer flexibility, distribution channel and logistic, are robust enough to satisfy the customers. However, one needs to be cautioned when adopting these research findings due to some research limitation.

Chapter 1

INTRODUCTION

1.1 Introduction

Supply chain management (SCM) is a popular topic today. Firms are using effective SCM to support their multiple manufacturing goals such as flexibility, cost, quality and delivery (Wacker, 1996). In today's competitive and uncertain environment, the flexibility of supply chain is crucial in satisfying the customers' changing need. A number of operations' innovative strategies such as agile manufacturing, lean manufacturing, synchronous manufacturing, product customization and time-based competition were introduced to improve the flexibility of the manufacturer. However, improvement solely on the manufacturer's capability is not enough to address the needs of the flexible supply chain. Upstream activities of the supply chain play a vital role in determining the flexibility of the chain (Cox, 2001).

With the shorter product lifecycle and increasing trend of outsourcing activities to divesting the non-core activities, the manufacturer needs to closely collaborate with its suppliers to ensure that the upstream activities are managed properly to meet the needs of its operation. Therefore, the supplier selection and supplier management strategies are viewed as an important strategic decision especially in this highly demanding, uncertain and competitive market. Proper selection and management of the right or preferred suppliers would allow the manufacturer to leverage on their best-in-class technical capabilities and expertise to further improve its supply chain flexibility. The volatility and variability of the supply chain requires more focus on product flexibility, launch flexibility and volume flexibility for the manufacturer to continuously stay competitive.

1.2 Research Problem

The intense global competition over the past decade has promoted supply chain management (SCM) as a corporate strategy and a timely topic for academic research. Manufacturers have used SCM to describe the integration and partnership efforts with first and second tier suppliers to improve the business performance. The objectives of these partnerships are to offer the lowest total cost, high-quality products and services with greater flexibility.

Manufacturers have utilized supplier strengths and technologies to support new product development efforts (Morgan & Monczka, 1995) and have drastically reduced supply bases to a handful of certified suppliers (Inman & Hubler, 1992). Most of the recent literatures on SCM focus on manufacturers' attempts to integrate processes and form alliances with suppliers to move efficiently and effectively manage the purchasing and supply function. Carter, Monczka, Slaight, and Swan (2000) forecast that supplier selection will increasingly be based on strategic contribution to the supply chain and will extend beyond first-tier suppliers. Early involvement of suppliers in product design, for instance, allows manufacturers to develop alternative solutions; to select the best and most affordable components, materials, and technologies; and to receive help in design assessment. Supplier involvement in product and process design and continuous improvement activities has been shown to have a positive impact on competitive advantage and performance (Vonderembse & Tracey, 1999). In general, SCM seeks to improve the performance through elimination of waste and better leveraging of internal and external supplier capabilities and technologies (Morgan & Monczka, 1996).

Since the supplier selection and management is very important in the supply chain management, a related question that arises in this context is, which supplier

selection and management strategies should be pursued by the manufacturer to enhance its flexibility? There is little empirical evidence to validate this view and these linkages of the relationship have not been well explored and understood.

1.3 Research Objectives

Empirical studies for achieving manufacturing flexibility goals have centered on the uses and advantages of advanced technology. Few studies have examined alternative ways of attaining flexibility objectives (Narasimhan, 1999). One of the possibilities is to study the emphasis of the manufacturer's supplier selection and management strategy and their contribution towards its flexibility. Therefore, this study is an attempt to fill this gap. The objectives of the study are:

1) To investigate the manufacturer's strategic decision in supplier selection strategy with respect to the manufacturing flexibility performance.
2) To investigate the moderation effect of the supplier management strategy on the relationship of the supplier selection strategy and the manufacturing flexibility.

1.4 Definition of Variables

For the purposes of this study, the following terms need clarification.

1.4.1 Supplier Selection Strategy

Supplier selection strategy is the strategy adopted by the manufacturer to evaluate and select the suppliers, which fulfill the requirements of the manufacturer. Therefore, the decision to engage any business with a supplier should always be based on a reasonable set of criteria. The strategy outlines in this study are technology, quality, cost and delivery performance.

Technology encompasses the scientific knowledge, processes, systems and equipment used to create products and services and to help people carry out their tasks. (Cook, Hunsaker & Coffey, 1997).

Quality is defined as meeting, or exceeding, customer requirements now and in the future (Schroeder, 2000). In the supply chain context, quality has come to include satisfaction of ultimate customers' needs, while extending simultaneously the quality definition to the start of the supply chain (Leenders & Fearon, 1997).

Cost is defined as so many dollars and cents per unit based on an average cost for raw material over a period of time, direct labor costs, and an estimated volume of production over a period of time on which the distribution of overhead is based (Leenders & Fearon, 1997). The cost goal is achieved when resource costs (labor, material, inventory and overhead) are at their minimum (Wacker, 1996).

Delivery has three traditional meanings: (1) Delivery reliability (percentage of on-time delivery), (2) speed of delivery for current products (product time fence or manufacturing lead-time), and (3) new product delivery (Hill, 1989).

1.4.2 Supplier Management Strategy

Supplier management strategy is the strategy used by the manufacturer to improve its supplier's performance and capabilities in order to meet the assurance of supply to the manufacturer. The activities involves are assessing supplier's operations, providing incentives to improve performance, instigating competition among suppliers, and working directly with supplier (Handfield, 2000).

In this study, supplier management strategy is scoped to supplier early involvement in manufacturer's design process, developing calibrated quality and technology roadmap, and implementing inventory management program.

1.4.3 Manufacturing Flexibility

Manufacturing flexibility is defined as the overall capability of a firm to respond to changes without incurring unreasonable penalties of time or cost (Narasimhan & Das, 1999). It is conceptualized in this study using its sub-dimension, which are product, launch and volume flexibilities.

Product flexibility or customization is the ability to handle difficult, nonstandard orders, to meet special customer specifications and to produce products characterized by numerous features, options, sizes and colors (Vickery, Droge & Markland 1997).

Launch flexibility refers to the ability to rapidly introduce many new products and product varieties to market (Vickery, Droge & Calantone 1999).

Volume flexibility is the ability to effectively increase or decrease aggregate production in response to customer demand (Roth & Miller 1990). It requires close coordination between a manufacturer and its suppliers, especially in the face of increasing demand. It is highly related to the market share growth.

1.5 Research Design

The study focuses on the supplier selection strategy as the independent or predictor variables and manufacturer's performance (product, launch and volume flexibility) as dependent variable. Supplier management strategy is postulated to be the moderating variable. Therefore, the most appropriate unit of analysis in this investigation is the business unit within an organization as each business unit differs from one another in terms of the supplier selection and management strategies dependence on its manufacturing activities.

The study is conducted by distributing a set of questionnaire to a selected sample of organizations. Careful consideration has to be given on the selection of the respondent in an organization, so that, only those related to the supplier selection and management activities in the organization are involved in this survey.

The relationships of variables are statistically tested using multiple and hierarchical regression analysis.

1.6 Significance of the Study

In today's competitive market, no single company can operate alone without depending on its suppliers. To meet the challenges of the new century, firms are re-thinking and re-organizing their supply base to make it an extension of its manufacturing operations. A well-defined and effective selection and management strategy is one of the approaches in improving and enhancing the manufacturing flexibility. The establishment of the strategy enhances the communication and creates an environment of trust that builds fertile relationships with suppliers. These relationships can improve the performance by eliminating supply stock-outs, increasing the probability of on-time delivery, improving supply quality and shorten the lead-time, which are all contributed to the supply chain flexibility. Therefore, the supplier selection strategy has become a strategic decision in defining excellent manufacturing flexibility.

With the research findings on the supplier selection and management strategies, it helps the manufacturer to re-look into their current strategies to ensure the right suppliers are selected using correct strategy when specific manufacturing flexibility is needed. Then, appropriate supplier management strategy can be implemented subsequently to ensure the continuous enhancement in the supply chain.

This will eliminate wrong focus of selection strategies in relation to the specific manufacturing flexibility, which may turn up to be very costly for the firms. With the right emphasis of supplier selection strategy, the firm can meet its product, launch and volume flexibility. In addition, the right choice of supplier management strategy will better collaborate the two organizations in the ongoing basis to continuously meet the end customer expectations.

1.7 Summary

The increased global competition means more volatile markets, shorter life cycles, and more sophisticated buyers, which have all contributed to flexibility's emergence as a new strategic imperative. In order to embrace the latest trend and continuously meeting or exceeding the final customer's needs, close collaboration between the manufacturer and suppliers is highly required. Therefore, by just concentrating on manufacturer's internal operation excellence is not enough to address the end customers' changing needs. Historically, manufacturer adopts its own supplier selection and management strategies, but literatures have lacked the empirical evidence that explicate the relationship of these strategies and the manufacturing flexibility. Hence, this study is to investigate the strategic decision of the manufacturer's supplier selection strategy on its product, launch and volume flexibility respectively. It is also attempted to determine the moderating effect of the supplier management strategy on the relationship of the supplier selection strategy and the manufacturing flexibility.

1.8 Outline of the Thesis

Chapter 1 introduces the importance of upstream activities in supply chain such as supplier selection and supplier management that can contribute to manufacturing performance. This chapter mainly focuses on the understanding of the problem, establishing the research objectives, defining the variables involved, and discusses the potential contribution of this study.

Literature review is presented in Chapter 2. Various literatures have been reviewed to understand the latest trends and academic topics in upstream activities in supply chain management especially on manufacturing flexibility, supplier selection and supplier management. The scope of manufacturing flexibility is narrowed to product, launch and volume flexibility. Agency theory has been used to understand the working relationship between the manufacturer and its suppliers.

Chapter 3 discusses the research design. A conceptual framework based on above 2 chapters' discussion is presented in this chapter. Two main hypotheses and research methodology including sampling, data collection method, questionnaire development, measures and statistical analysis are covered in this chapter.

The statistical result of the study is analyzed and discussed in Chapter 4. Firstly, the descriptive and reliability analysis of the data are performed. Secondly, 3 multiple regressions are carried out on the first research question. Lastly, twelve 3-stage hierarchical regressions are performed on the second research question.

The last chapter wraps up the whole study by discussing on the findings, its implication, limitation of the study and suggestion for future research.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

Today, as time to market continues to compress due to customers changing demands, manufacturers are responding with a complementary reduction in product lifecycles (Signal, 1999). In order to meet this variability of demand, manufacturer needs to incorporate flexible supply chain in their operations that are scalable and adaptable to achieve shorter order fulfillment lead-time. Watts, Kim and Hahn (1990) emphasized that an organization's ability to produce a quality product at a reasonable cost and in a timely manner, is heavily influenced by its suppliers' capabilities.

A key dimension in supply chain performance is flexibility. Flexibility is one of the important objectives in Operation Strategy Model (Schroeder, 2000) and is often seen as a reaction to environmental uncertainty (Suarey, Cusumano, & Fine 1991; Gerwin, 1993). Flexibility is described as the ability of a manufacturing system to cope with environmental uncertainties (Barad & Sipper, 1988). Although there are many ways to characterize supply chain flexibility, for example, manufacturing flexibility and marketing flexibility (Vickery, Calantone & Droge 1999), this research is focus on manufacturing flexibility, which can be further categorized to product flexibility, launch flexibility and volume flexibility. In general, flexibility reflects an organization's ability to effectively adapt or respond to changes that add value in the customer's eyes (Upton, 1995).

There is lack of particular theory that can be used to explain the supplier selection and management strategy, which influence the manufacturing performance especially on manufacturing flexibility. One has to knit together scattered literatures on the topics including operations management, strategic management, purchasing

and inventory management, business and manufacturing strategy in order to facilitate research of this topic. Agency theory has been used to explain the principal-agent relationship between the manufacturer and its suppliers.

2.2 Manufacturing Flexibility

Manufacturing flexibility refers to the quickness and ease with which plants can respond to changes in market conditions. Thus, the concept of flexibility is essentially a measure of the efficiency of the process of change. It derives from the efficiency of the production system not in making products, but in changing either the number or types of product made. Manufacturing flexibility is affected by "upstream" uncertainties such as supplier defaults on delivery and performance, machine breakdowns, rejects, variable task times; as well as "downstream" uncertainties due to demand volatility and changes in product mix, price, and competition action (Zelenovic, 1982; Gupta & Goyal, 1989). A dominant feature of the academic literature is the use of taxonomies of flexibility, which classify different types of manufacturing flexibility (Narasimhan & Das, 1999). For the purpose of this research, three types of flexibilities are investigated, namely product flexibility, launch flexibility and volume flexibility.

2.2.1 Product Flexibility

Pine (1993) emphasizes the increasing importance of product flexibility in today's competitive environment. Product flexibility is a value-adding attribute that is immediately visible to the customer and requires the effective collaboration of the internal and external functional players, including marketing, product design and development, engineering and suppliers. Vickery (1997) found that product flexibility

was significantly related to financial and marketing performance. There is no literature showing supplier selection and management is directly contributing to the product flexibility, and it is one of the intentions of this research paper to fill the gap.

2.2.2 Volume Flexibility

Volume flexibility directly impacts customers' perceptions by preventing out-of-stock conditions for products that are suddenly in high demand. Hayes and Wheelwright (1984) describe the importance of this capability in a highly cyclical industry such as furniture, emphasizing the necessity of being able to accelerate or decelerate production very quickly and juggle orders so as to meet demands for unusually rapid delivery. Volume flexibility requires close coordination between a manufacturer and its suppliers, especially in the face of increasing demand. The empirical study has indicated that volume flexibility and launch flexibility are key responses to marketing practice uncertainty and product uncertainty, respectively (Vickery, Calantone & Droge, 1999).

2.2.3 Launch Flexibility

As the product life cycles dramatically decrease, increasing strategic emphasis is being placed on bringing many new products to market as quickly as possible since it provides companies a real competitive advantage. The launch flexibility bring the following advantages:

- Pioneering performance advantage, where early market entry is related to higher market share or profitability (Robinson et al., 1992);
- Quality image perception advantage, where the early entrant has the first opportunity to build and nurture a long-term relationship with the buyer and

search costs would induce the buyer to remain with the early entrant (Hauser & Wernerfelt, 1990);

- Innovation leadership advantage, where technology superiority is perceived by customer; scale and experience economy advantages, where early entrant can gain production efficiencies from early buildups of experience and size advantages (Lieberman & Montgomery, 1988).

2.3 Importance of Supplier in SCM

In the current competitive environment, suppliers are important resources for manufacturers. Across all worldwide manufacturers, purchased materials account for over 50% of the cost of goods sold. In addition, suppliers have a large and direct impact on the cost, quality, technology, and time-to-market of new products (Handfield, Ragarz, Petersen & Monczka, 1999). Thus, it is imperative for the manufacturer to spend a great amount of time in communicating, developing, monitoring and growing together with its suppliers. In many industries, the management of suppliers can account for as much as 60% and 80% of manufacturing cost (Asmus, David & Griffin, 1993). The management of supplier relationship is a vital task for manufacturers as it can contribute to both the competitiveness and profitability of a company (Lemke et al., 2000). As highlighted by Christopher and Martin (1997), effective supplier management can take costs out of the supply chain.

Supplier selection and management require the manufacturer and supplier to commit financial, capital, and personnel resources to build the relationship. The manufacturer must be convinced that investing company's resources in a supplier is a worthwhile risk, which grant some benefit to the manufacturer such as lower cost and quality parts, competitiveness and customer satisfaction. On the other hand, the

supplier must realize that its best interest lies in accepting the direction and assistance from its customer with expectation of some rewards such as earning abnormal profit, growth opportunity and others. The relationship can be best explained by using agency theory. So far, agency theory is used to guide the transportation user and provider in evaluating outsourcing relationships (Logan, 2000), and attempts to describe the relationship using the metaphor of a contract (Jensen & Meckling, 1976).

Agency theory centers around two parties, a principal (manufacturer) and an agent (supplier) who collaborate with each other to achieve certain outcomes. This theory is concerned with resolving two problems that can occur in agency relationships. The first agency problem arises when (a) the desires or goals of the principal and agent conflict, and (b) it is difficult or expensive (agency cost) for the principal to verify what the agent is actually doing. The general agency costs include the costs of structuring, monitoring, and bonding a set of contracts among agents and principals with conflicting interests. The second problem of risk sharing arises when the principal and agent have different attitudes towards risk. The principal and the agent may prefer different actions because of the different risk preferences (Eisenhardt, 1989).

In order to achieve a "win-win" situation, both the manufacturer and its supplier need to compromise and come to a set of common interest for them to get involved in the partnership. By having this partnership, they can grow faster in terms of business and technology, and outperform their competitors to gain more benefit for both sides.

2.4 Supplier Selection Strategy

Supplier selection strategy is the strategy adopted by the manufacturer to evaluate and select the suppliers, which fulfill the requirements of the manufacturer. To build more effective relationship with suppliers, organizations are using supplier selection criteria to strengthen the selection process. It is indicated that the supplier selection criteria is changing with the new challenge to select suppliers who can add long-term value to the manufacturer (Lemke, Goffin & Szwejczewski, 2000).

Based on the empirical data collected from 170 purchasing managers, members of the National Association of Purchasing Management, Dickson (1966) identified quality, cost and delivery performance history as the three most important criteria in supplier selection. According to a review of 74 articles discussing supplier selection criteria, quality was perceived to be the most important, followed by delivery performance and cost (Weber et al., 1991). The selection of suppliers is critical for several reasons. First, the trend towards "just-in-time" manufacturing practices has resulted in a supply base reduction (Pearson & Ellram, 1995). Second, owing to resource scarcity, there is a need for greater interaction between the buyer and the supplier. Third, many firms involve their suppliers early in the planning process so that they are able to deliver superior value to their customers (Trent & Monczka, 1998). In order to release products quickly, supplier selection occurs at the front end of the program, long before the specifications are laid out. Sun System involves supplier by reviewing their technology roadmaps to determine what technology is emerging that Sun may be able to use in future products (Teague, 1997). By bringing the market-leading technologies into the design process at an early stage, suppliers can help the manufacturer in reducing the lead-time and improve the product's performance. Supplier also can assist manufacturers in understanding the

adoption of new technologies can improve their product, launch and volume flexibility.

The supplier selection strategy in terms of technology, quality, cost and delivery performance are important strategies in overcoming the "upstream" uncertainties, such as supplier defaults on delivery and performance, and quality rejects; as well as "downstream" uncertainties due to demand volatility and changes in product mix, price, and competition action, which resulted in much flexibility in its manufacturing process. However, each of the selection strategy has its own influencing effect on different manufacturing flexibility.

To meet the timeline of new product introduction, the manufacturer must be very careful in its supplier selection strategy to ensure any proprietary information would not be disclosed to their competitors.

2.5 Supplier Management Strategy

Supplier management strategy is the strategy used by the manufacturer to improve its supplier's performance and capabilities to meet the manufacturer's short-term or long-term supply needs. Supplier management is concerned with organizing the optimal flow of high-quality, value-for-money materials or components to manufacturing company from a suitable set of innovative suppliers (Goffin, 1997). This strategy allows the manufacturer to bridge the gaps, after the supplier selection process, between its suppliers' capabilities and its own expectation. It is impossible to find the supplier who matches 100% the needs of the manufacturer in the initial selection process.

Effective supplier management can take costs out of the supply chain. By involving suppliers in product development activities and continuous improvement

efforts, suppliers learn about customer requirements, culture, and decision-making patterns, which help them to be more efficient in meeting the manufacturer's expectation (Cocks, 1996; Epatko, 1994, Leenders, 1994; Minahan, 1996;Morgan, 1996; Towler, 1996). These strategies help organizations enhance communication, share knowledge, improve decision-making, and upgrade supplier and manufacturer's performance. Vonderembse and Tracey (1999) found that although both the supplier selection criteria and the supplier involvement are positively correlated with manufacturing performance, the supplier involvement in product design activities and continuous improvement efforts is much lower than the use of supplier selection criteria. Early supplier involvement has an even greater benefit, a shortening of design cycle time, which means faster launch flexibility. However, there is lack of literature, which relates directly this strategy and the manufacturing flexibility.

In automobile industry especially for Japanese companies, supplier management in terms of lean manufacturing (technology), JIT delivery and inventory management had proved to help address the needs for supply chain flexibility (Liker & Yen Chun, 2000). According to Clark and Fujimoto (1989), supplier involvement and strong supplier partnerships account for almost 33% of the man-hour advantage, and the four to five month lead-time advantage enjoyed by the Japanese auto companies over U.S. car makers. The partnerships are particularly critical in JIT environment where there is little inventory to cushion production, scheduling and usage problems.

Establishment of technology and quality roadmap is believed to be one of the important activities in supplier management. BMW published a Supplier Partnership Manual and held seminars for suppliers to present their "Road Map to Quality", helped BMW to be 20% above the industry average in several quality-performance

categories. This manual clearly delineates supplier responsibilities and expectations and is geared toward improving alignment between the corporate cultures (Handfield, 2000). Such road maps are becoming increasingly common to spur manufacturer and supplier organizational alignment. They attempt to show companies where they are today and project where they should be in the short, medium and long term.

Supplier management strategy is to ensure the supplier can continuously meet and perform up to the expectation of the manufacturer. By involving supplier in the early stage of design, having clear quality and technology roadmap, and proper inventory management program, the manufacturer is more ready to combat the war of uncertainty in its supply chain.

2.6 Conclusion from the Literature Review

As the manufacturing environment become more drastic, supplier selection is the first step in identifying supplier with best-in-class technology, good quality, total lowest cost and good delivery performance record, which can match the manufacturer's flexibility needs. However, there is lack of literature, which relates the supplier selection strategy on the manufacturing flexibility. It is found that the subsequent supplier management strategy can ensure the supplier is committed in meeting the manufacturer's expectation, and continuously stay abreast with the changing needs of the manufacturers to improve on its manufacturing flexibility. Supplier early involvement in manufacturer's design process, clear technology and quality roadmap, and good inventory control program are all geared towards enhancing the flexibility of the manufacturer.

Chapter 3

RESEARCH DESIGN

3.1 Conceptual Framework

The highly uncertain business environments have driven the manufacturers to improve its supply chain flexibility in order to meet the customers' changing demands. Apart from the internal operation excellences, one of the potential areas that the manufacturer can work on to improve its flexibility is the upstream activity such as supplier selection and supplier management. By having right strategy in supplier selection with respect to difference flexibilities, the manufacturer can enhance its manufacturing performance. Therefore, this study is to investigate the manufacturer's strategic decision in supplier selection and management strategies with respect to its manufacturing flexibility.

One of the key performance measures of the manufacturer is flexibility. There are many types of manufacturing flexibilities but this study is only focus on three types of manufacturing flexibilities, namely product, volume and launch flexibility. Apart from the internal factors such as manufacturer's equipment and processes, which affect the flexibility, external factors, for instance, supplier performance and capability also play a major role in influencing manufacturing flexibility.

In order to improve its manufacturing flexibility, the manufacturer must adopt the appropriate strategy to select the supplier, who can meet its requirement and expectations. The strategy outline in this study is supplier's technology, quality, cost and delivery performance. All these strategy are believed to have different level of influence on product, volume and launch flexibility.

The manufacturer's supplier management strategy can bring the gap of the manufacturer and suppliers closer through through supplier early involvement in the design of product, establishment of clear supplier quality and technology roadmap and possess proper inventory management program.

The literature review thus far linked the manufacturing flexibility to the adoption of the advanced technology used by the manufacturer. There is a lack of evidence, which link directly the manufacturing flexibility to the manufacturer's strategy on its supplier selection and management. Thus, a theoretical framework is drawn as depicted in Figure 3.1 to link up the relationship of supplier selection strategy and manufacturing flexibility. Supplier selection strategy consists of technology, quality, cost and delivery performance, which are all independent or predictor variables. The dependent variable is product, launch and volume flexibility in each 3 models. In this model, supplier management strategy, which is made up of supplier early involvement, quality roadmap, technology roadmap and inventory management act as moderators.

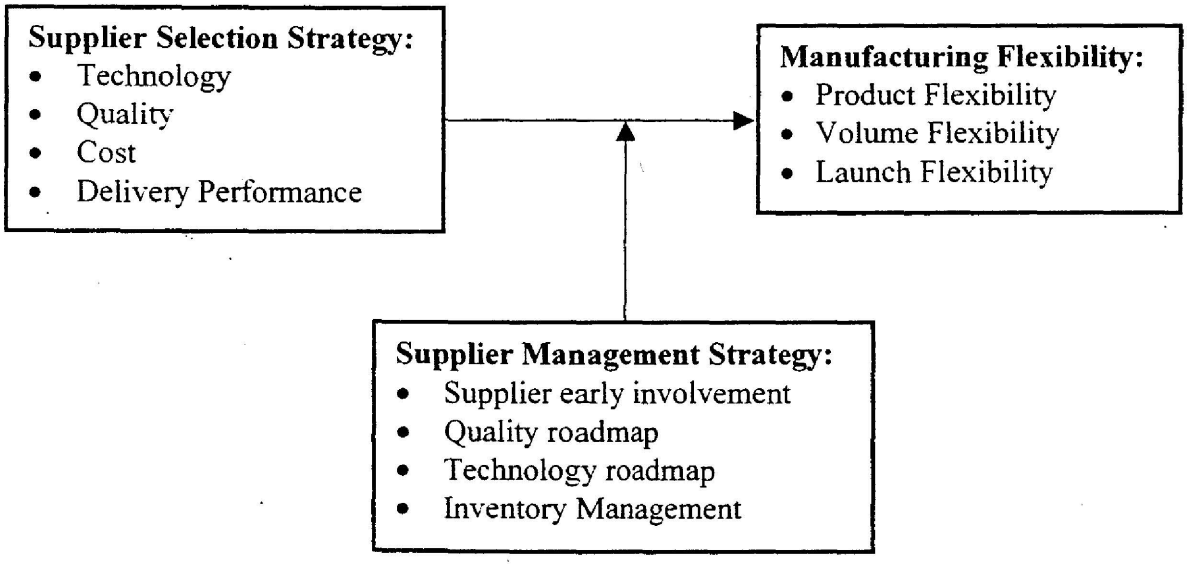

Figure 3.1: Conceptual Model of Supplier Selection and Management Strategy and Manufacturing Flexibility

In short, to improve manufacturing flexibility, manufacturer's supplier selection and management strategies should not be neglected. Right supplier selection strategy with respect to each of the manufacturing flexibility is important in addressing the criticality of supply chain flexibility especially in such a high demand fluctuating market. The following supplier management strategy is believed to better tie the working relationship of the manufacturer and suppliers.

3.2 Hypothesis

The intent of the study is to answer the questions pertaining to the manufacturer' strategic decision in its supplier selection and management strategies, which are regarded as one of the important elements in improving the manufacturing flexibility.

With the increasing outsourcing activities and shorter product life cycle, suppliers' role in supporting manufacturer's operation has become more important. Thus, the manufacturer must place emphasis in the supplier selection process since it determines the first right decision to make. By selecting the right or preferred suppliers, the manufacturer can improve its own manufacturing flexibility to compete with its rivals in this volatile environment.

It has been concluded from a few literatures that the typical supplier selection criteria are quality, cost and delivery. Technology has emerged as another important criteria in view of shorter product life cycle, which demanded state-of-art technology to bring the new product to the market rapidly. By putting correct emphasis in these four selection criteria, the manufacturer can enhance its manufacturing flexibility to cope up with cyclical demand.

Suppliers' technology, part quality, cost structure and on time delivery are important elements for manufacturer to customize its product to customer's unique

specification. The supplier must possess broad technology bandwidth, which allows the parts to be produced quickly and economically. The supplier also must ensure that the quick-turned parts are good quality, which can be delivered on time. Right selected supplier ensures the manufacturer from facing stock-out or assurance of supply problem by consistently deliver good quality parts on time economically, even though there is fluctuation in demand.

New product introduction requires the manufacturer to work closely with suppliers to ensure that the launching of new product to market is on time. Therefore, the right choice of supplier in terms of technology, part quality, delivery and cost are imperative to help the manufacturer to become the first mover in the industry. This flexibility determines the growth of the manufacturer's market share. With the above discussion, the first hypothesis drawn is as following:

Hypothesis 1: The manufacturer's strategic decision in supplier selection strategy will result in different level of manufacturing flexibility.

Sub Hypothesis 1a: The greater emphasis of technology compared to quality, cost and delivery will result in different level of product flexibility.

Sub Hypothesis 1b: The greater emphasis of technology compared to quality, cost and delivery will result in different level of launch flexibility.

Sub Hypothesis 1c: The greater emphasis of technology compared to quality, cost and delivery will result in different level of volume flexibility.

The right selection strategy only, does not guarantee the long run and consistent performance of the supplier to meet the expectation of the manufacturer. It has been concluded indirectly in numerous literatures that appropriate supplier management strategy will continuously improve the manufacturer's performance such as quality, delivery and cost. However, there is lack of literature, which investigates

the relationship of the manufacturing flexibility and the supplier management strategy. In this study, the relationship of the supplier selection strategy and the manufacturing flexibility is believed to be moderated by the supplier management strategy.

Hypothesis 2: The supplier management strategy moderates the relationship of supplier selection strategy and the manufacturing flexibility.

Hypothesis 2a: The supplier early involvement moderates the relationship of supplier selection strategy and product flexibility.

Hypothesis 2b: The supplier early involvement moderates the relationship of supplier selection strategy and launch flexibility.

Hypothesis 2c: The supplier early involvement moderates the relationship of supplier selection strategy and volume flexibility.

Hypothesis 2d: The quality roadmap moderates the relationship of supplier selection strategy and product flexibility.

Hypothesis 2e: The quality roadmap moderates the relationship of supplier selection strategy and launch flexibility.

Hypothesis 2f: The quality roadmap moderates the relationship of supplier selection strategy and volume flexibility.

Hypothesis 2g: The technology roadmap moderates the relationship of supplier selection strategy and product flexibility.

Hypothesis 2h: The technology roadmap moderates the relationship of supplier selection strategy and launch flexibility.

Hypothesis 2i: The technology roadmap moderates the relationship of supplier selection strategy and volume flexibility.

Hypothesis 2j: The inventory management moderates the relationship of supplier selection strategy and product flexibility.

Hypothesis 2k: The inventory management moderates the relationship of supplier selection strategy and launch flexibility.

Hypothesis 2l: The inventory management moderates the relationship of supplier selection strategy and volume flexibility.

3.3 Research Methodology

The research methodology covers the sampling, data collection method, questionnaire development, measures and statistical analysis.

3.3.1 Population Sampling

The population for this study consists of the manufacturing firms located in Penang State. The manufacturers are involved in semiconductor, computer and computer peripherals, telecommunications, electrical products and instruments industries. The population frame is drawn from companies listed in the Factory Directory published by Penang Development Corporation (PDC) in 1997.

The unit of analysis for this study is the business unit, which has manufacturing activities. Distributor, logistic and servicing organizations are excluded from this survey. As such, using the probabilistic method of sampling may not achieve the level of representation desired in this study. Instead, a purposive sampling method (non-probabilistic) is used in the sampling design. This is due to the study whereby only specific targets that have manufacturing activities are in the best position to provide the desired information for this study.

3.3.2 Data Collection Method

Data collection is accomplished primarily by email, mail and personal delivery. The sampled companies selected are contacted in advance by telephone or email. A self-addressed, stamped envelope is included to facilitate the return of the completed questionnaire. A follow up telephone call or email are made a week after the survey questionnaire is mailed out. The respondents for this study comprised of purchasing or procurement manager, material manager, supply chain manager and procurement executive whose nature of job scope are in frequent business contact with their suppliers.

3.3.3 Questionnaire Development

The design of the questionnaire is derived from the issues and questions raised in the literature. Some of the questions are taken directly from the past questionnaires and some are tailor-made to the model requirements (Narasimhan, 1999; Khaw Phaik Lean, 1999). Academician with expertise in the area is approached before developing the questionnaire. Personal interviews is also conducted with individuals who have vast experiences in supplier selection and management field as well as supply chain management. Once the suggestions are incorporated in the questionnaire, the entire of questionnaire is pretested.

The second stage of data collection is the pretest of the questionnaire. The pretest is performed on 3 purchasing managers to ensure that issues of concern are correctly addressed and also to ensure the clarity, validity of the questions raised. Changes are made based on the initial feedback and completed questionnaire is considered the final version.